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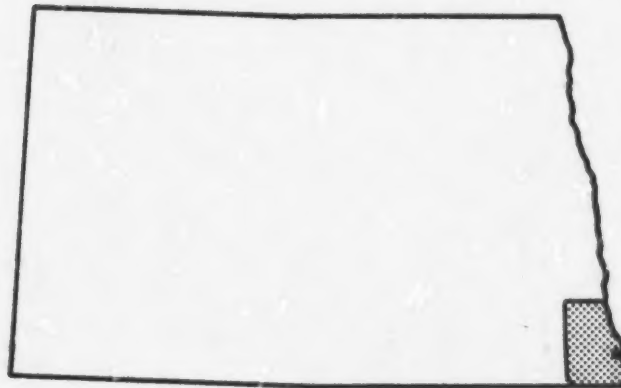
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FLOOD INSURANCE STUDY



ORIGINAL

TOWNSHIP OF
CENTER,
NORTH DAKOTA
RICHLAND COUNTY



Federal Emergency Management Agency

COMMUNITY NUMBER - 380648

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

FLOOD INSURANCE STUDY
CENTER TOWNSHIP, RICHLAND COUNTY, NORTH DAKOTA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in Center Township, Richland County, North Dakota, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency No. IAA-EMW-E-1153, Project Order No. 1, Amendment 27. This study was completed in January 1986.

1.3 Coordination

Streams requiring detailed study were identified by a FEMA representative during a telephone discussion with COE representatives in 1983.

A floodway coordination meeting was held in the City of Wahpeton, on June 20, 1985. Attending the meeting were representatives of the township, the City of Wahpeton, the North Dakota State Water Commission (NDSWC), and the Corps of Engineers (COE).

On July 14, 1986, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Center Township, North Dakota. The City of Wahpeton including area subject to its extraterritorial jurisdiction is not included. The area of study is shown on the Vicinity Map (Figure 1).

Riverine flooding on the Bois de Sioux River from the downstream Center Township boundary (Section line 20-29) to the upstream township boundary (Section line 32-5) was studied by detailed methods in conjunction with the Wahpeton, North Dakota Flood Insurance Study (Reference 1). Riverine flooding on the Wild Rice River from County State Aid Highway 13 upstream to the southern township boundary (Section line 31-6) was also studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through January 1991.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and representatives of Center Township.

2.2 Community Description

Center Township is located in the central portion of Richland County in southeastern North Dakota. The township is located approximately 200 miles southeast of Bismarck, North Dakota; approximately 40 miles south of Fargo, North Dakota; and approximately 220 miles northwest of Minneapolis, Minnesota. Center Township is bordered by Richland County to the north, west, and south, Wahpeton City on the northeast and Wilkin County, Minnesota on the southeast. The total land area within the township is approximately 46 square miles.

The economy of the township depends primarily on agriculture and related enterprises.

The climate of Center Township is typical of the Great Plains, characterized by cold winters and warm summers. Monthly average temperatures range from a low of 9.6 degrees F. in January to a high of 73.1 degrees F. in July. The mean annual temperature is 43.3 degrees F. The area averages 20.38 inches of rainfall annually (reference 2). The majority of the precipitation occurs between April and August.

Primary land uses in the township are residential and agricultural. Development in the Wild Rice River floodplain consists of agricultural and residential structures.

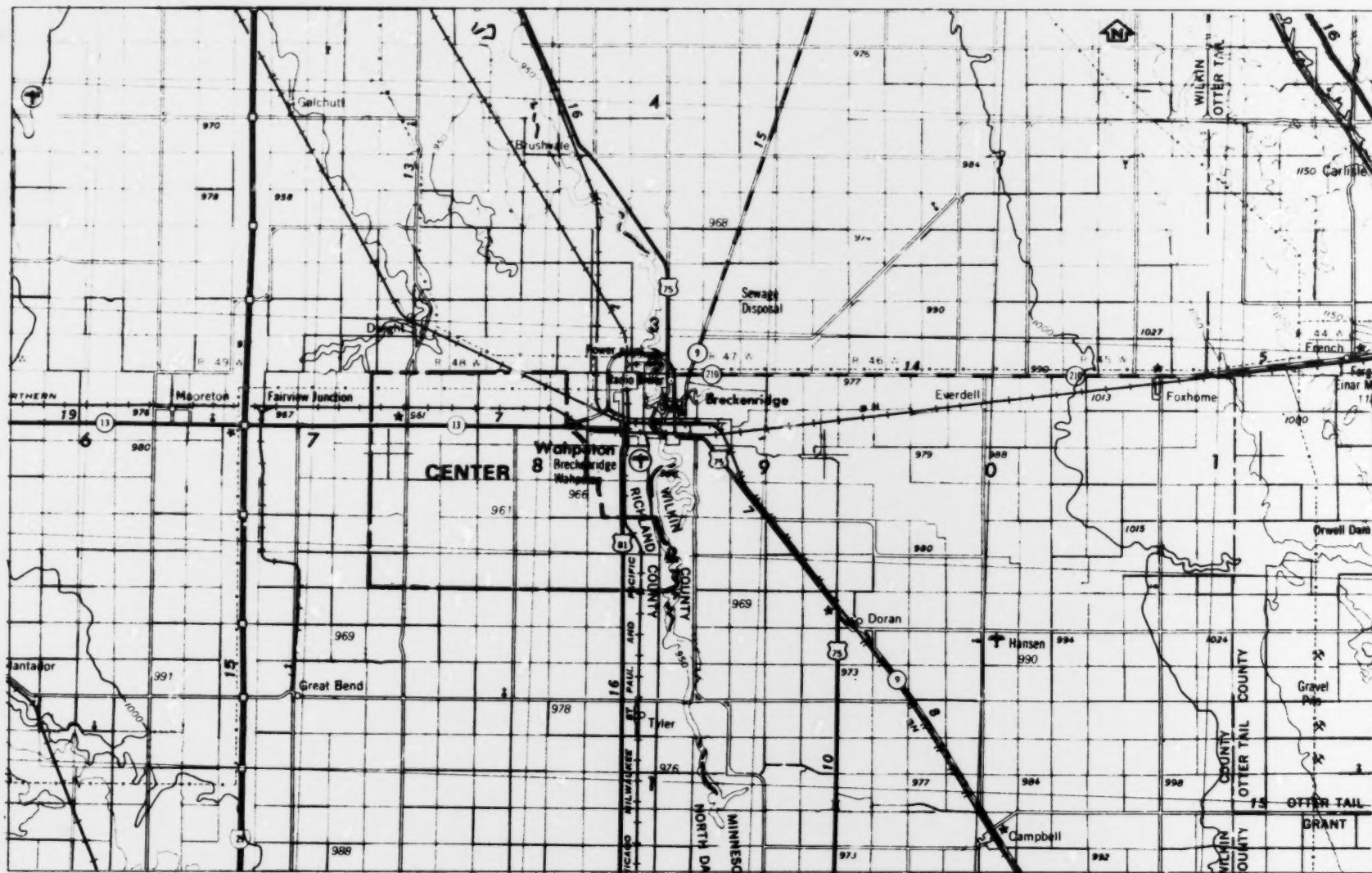


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF CENTER, N.D.
 (RICHLAND CO.)

APPROXIMATE SCALE



VICINITY MAP

3

2.3 Principal Flood Problems

Low lying areas adjacent to the Wild Rice and Bois de Sioux Rivers are subject to periodic flooding. The most severe flooding in Center Township usually occurs as a result of spring snowmelt and/or rainfall. Structures subject to flooding consist primarily of residential and agricultural buildings. Table 1 presents historic flood data at the Wahpeton, North Dakota, United States Geological Survey (USGS) gaging station (Reference 3).

TABLE 1. HISTORIC FLOOD DATA
RED RIVER OF THE NORTH, WAHPETON, NORTH DAKOTA

<u>Date</u>	<u>Flow, cfs</u> ¹	<u>Estimated Recurrence Interval</u>
1897	10,500	83
1969	9,200	50
1952	7,130	21
1979	7,050	20
1978	6,250	14
1951	6,090	11
1965	5,690	10
1962	5,650	10

¹ Cubic feet per second.

2.4 Flood Protection Measures

There are no certified, permanent flood control projects in existence in Center Township.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1 and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For

example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Discharges for the Bois de Sioux River upstream of Wahpeton were developed by the U.S.G.S in 1970 for the Breckenridge, Minnesota Flood Insurance Study (Reference 4). These flows were determined by analyzing the contributing flows from both the Bois de Sioux River and the Otter Tail River using a HEC-2 approximation of the 1969 flood at Wahpeton.

Discharges for the Wild Rice River were developed from a statistical analysis of flow data available for the years 1943 to 1975 at Mantador, North Dakota (U.S.G.S. Gage No. 05052000) following the guidelines specified in Bulletin 17B (Reference 5). The resulting discharges at Mantador were transferred to Center Township using the drainage basin transfer method with a coefficient of 0.6.

Peak discharges of the the Bois de Sioux River upstream of Wahpeton and the Wild Rice River at Center Township are shown in Table 2.

TABLE 2. SUMMARY OF DISCHARGES

<u>Flooding Source and Location</u>	<u>Drainage Area (square miles)</u>	<u>Peak Discharge (cfs)</u>			
		<u>10-year</u>	<u>50-year</u>	<u>100-year</u>	<u>500-year</u>
Bois de Sioux River above Wahpeton	1,967	3,670	5,300	6,200	9,760
Wild Rice River at County State Aid Highway 13	1,605	1,110	2,480	3,190	5,440

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations of floods of the selected recurrence intervals on both the Wild Rice River and the Bois de Sioux were computed through the use of the COE HEC-2 step-backwater computer program (Reference 6).

Overbank cross section data and below-water sections (soundings) for backwater analyses of the Bois de Sioux and Wild Rice Rivers were obtained by field measurement (Reference 7). All bridges, dams, and culverts were field-surveyed to obtain elevation and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Roughness factors (Manning's "n") used in the hydraulic computation were chosen by engineering judgement and are based on field observation of the streams and floodplain area. The roughness values selected for the main channel of the Bois de Sioux River ranged from 0.045 to 0.052, whereas the floodplain roughness values ranged from 0.080 to 0.090. Roughness for the main channel of the Wild Rice River was 0.040, while the floodplain roughness value was 0.070.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected intervals. Starting water-surface elevations for the hydraulic model of the Bois de Sioux River were based on water-surface elevations from the Wahpeton, North Dakota, Flood Insurance Study (Reference 8). Starting water-surface elevations for the hydraulic model of the Wild Rice River were based on normal depth calculations approximately one mile downstream of the study limits.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the one percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries for the Wild Rice River were interpolated using enlarged U.S. Geological Survey quadrangle maps at a scale of 1:400, with a contour interval of 10 feet (Reference 8). The flood boundaries for the Bois de Sioux River were photogrammetrically plotted (Reference 9).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and AH); and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2). Approximate 100-year floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map (Reference 10). The floodplain boundaries in the area along Wild Rice River north of CSA Highway 13 were adjusted to reflect the more accurate data available from this study.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is

used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. In North Dakota, an increase of 1.0 foot is permitted except for boundary water between North Dakota and Minnesota where floodplain encroachment is limited to a 0.75 foot increase in flood heights above pre-floodway conditions at any point (Reference 11) with 0.25 foot increase attributed to Minnesota and 0.5 foot increase attributed to North Dakota. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies. Floodways on the Bois de Sioux River extend beyond the Township limits into Wilkin County, Minnesota.

The floodways presented in this study reflect a township selected alignment. The floodway alignment has been coordinated with the NDSWC and the Minnesota Department of Natural Resources. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3). Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than the allowable amount at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH ² (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE ³
Bois de Sioux River								
A	240	416/300	4,200	1.5	962.4	962.4	963.1	0.7
B	1,250	390/190	3,415	1.4	962.5	962.5	963.2	0.7
C	3,585	436/330	3,871	1.6	962.7	962.7	963.4	0.7
D	6,660	500/170	4,242	1.5	963.1	963.1	963.7	0.6
E	9,520	556/420	4,126	1.5	963.4	963.4	964.1	0.7
F	11,840	550/150	3,922	1.6	963.8	963.8	964.4	0.6
G	14,375	550/360	3,856	1.6	964.2	964.2	964.7	0.5
H	16,780	650/410	4,225	1.5	964.6	964.6	965.1	0.5

¹ Feet above the downstream township boundary. ² Total floodway width/floodway width within township boundary. ³ 0.50 foot increase allowable by North Dakota and 0.25 foot increase allowable by Minnesota for a 0.75 foot maximum increase total.

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CENTER, ND
(RICHLAND COUNTY)

FLOODWAY DATA

BOIS DE SIOUX RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH ² (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE ³
(FEET NGVD)								
Wild Rice River								
A	219	256	1985	1.6	956.7	956.7	957.3	0.6
B	3,000	405	2251	1.4	957.2	957.2	957.7	0.5
C	7,340	300	1860	1.7	957.8	957.8	958.2	0.4
D	9,160	400	2654	1.2	958.3	958.3	958.7	0.4
E	12,620	360	1958	1.6	958.7	958.7	959.0	0.3
F	16,270	700	2343	1.4	959.1	959.1	959.5	0.4
G	19,730	605	3593	0.9	959.4	959.4	960.0	0.6
H	23,370	300	1836	1.7	959.8	959.8	960.3	0.5
I	26,910	210	1754	1.8	960.5	960.5	960.9	0.4
J	31,600	550	2923	1.1	961.3	961.3	961.6	0.3
K	34,737	300	2171	1.5	961.7	961.7	962.0	0.3
L	37,150	483	2770	1.2	961.9	961.9	962.2	0.3
M	40,370	350	1947	1.6	962.2	962.2	962.5	0.3
N	42,630	400	2334	1.4	962.5	962.5	962.8	0.3
O	43,850	415	3008	1.1	962.7	962.7	963.0	0.3
P	46,200	400	2178	1.5	962.8	962.8	963.1	0.3
Q	4,8700	400	2742	1.2	963.3	963.3	963.6	0.3

¹ Feet above the centerline of State Highway 13 west.

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CENTER, ND
(RICHLAND COUNTY)

FLOODWAY DATA

WILD RICE RIVER

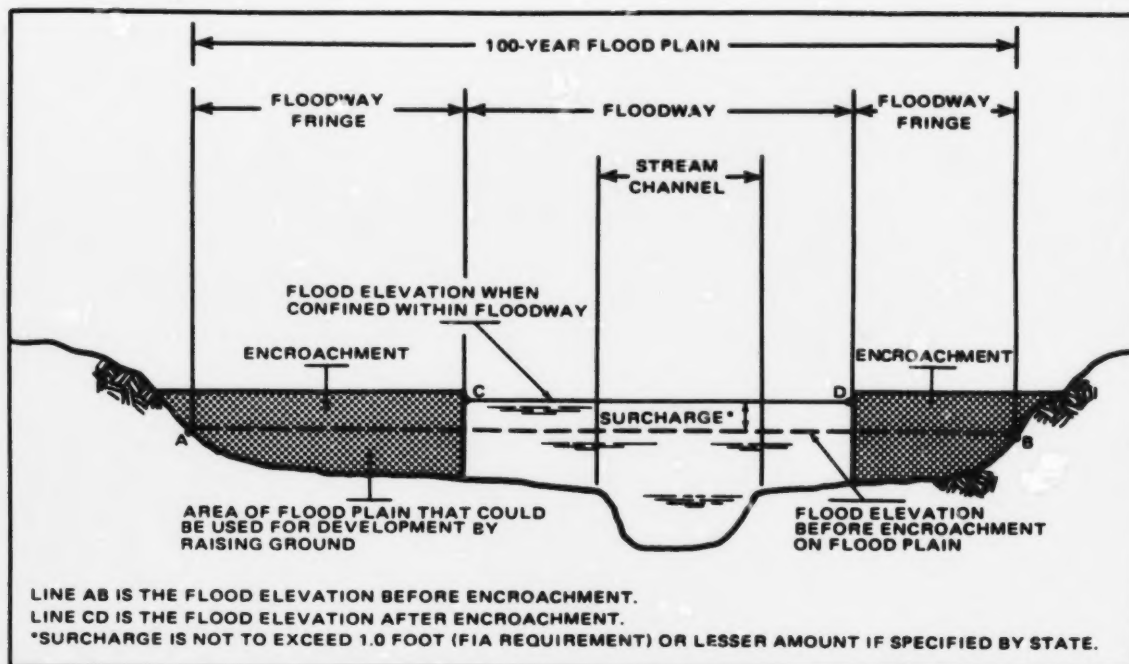


Figure 2. Floodway Schematic

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

A Flood Insurance Study is being conducted for the City of Wahpeton, North Dakota (Reference 1). The results of this study will match exactly the results of the City of Wahpeton study.

In 1981, FEMA published a Flood Hazard Boundary Map for Richland County, which includes Center Township (Reference 10). The Approximate flooding in some areas shown in this study was taken from the Richland County Flood Hazard Boundary Map. Other approximate flooding on Wild Rice River downstream of C.S.A. Highway 13 was adjusted to reflect the more accurate data obtained during this most recent study. Because of the more detailed and current hydrologic analysis, this Flood Insurance Study supersedes the data presented on the Flood Hazard Boundary Map on the Bois de Sioux River and Wild Rice River within the study limitations.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

9.0 BIBLIOGRAPHY AND REFERENCES

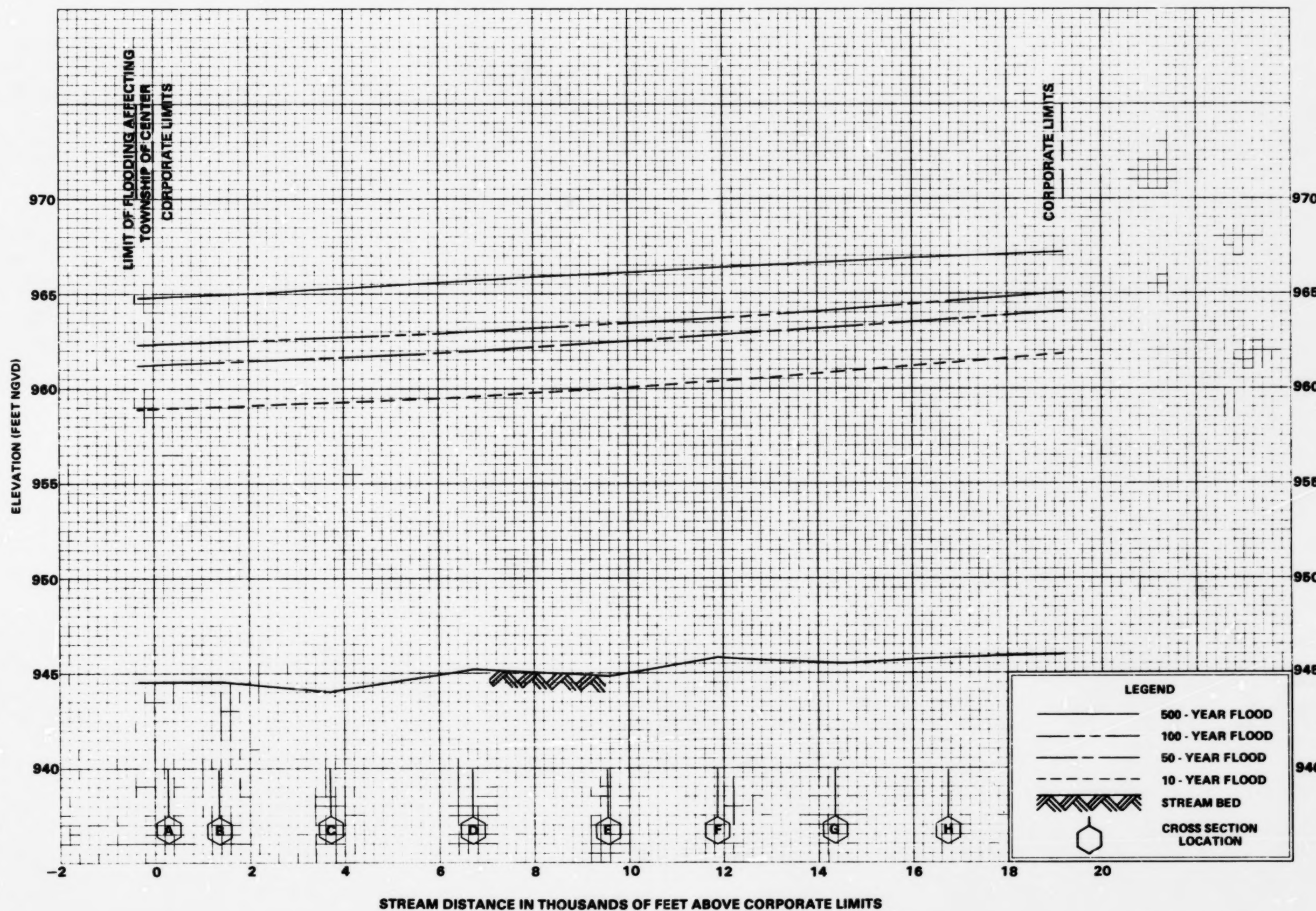
1. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Wahpeton, North Dakota, unpublished.
2. North Dakota State University, Climate of North Dakota, Jensen, 1980.
3. U.S. Department of the Interior, Geological Survey, Water Resources Data for North Dakota.
4. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Breckenridge, Minnesota, April 1970.
5. U.S. Water Resources Council, Bulletin 17B, Guidelines for Determining Flood Flow Frequency, revised September 1981.
6. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, Computer Program 723-X6-L202A, HEC-2 Water-Surface Profiles, Davis, California, March 1982.
7. U.S. Department of the Army, Corps of Engineers, St. Paul District, Field Survey Measurements for Center Township Flood Insurance Study, 1984.
8. U.S. Department of the Interior, Geological Survey, 7.5 - Minute Series Topographic Maps, scale 1:24,000 enlarged to 1"=400', contour interval 10 feet; Dwight, North Dakota (PR 1979); Fairmont NW, North Dakota (1964); Wahpeton, Minnesota-North Dakota, (PR 1979); South of Wahpeton, Minnesota-North Dakota, (1973).
9. Mark Hurd Aerial Surveys, Inc., 345 Pennsylvania Avenue South, Minneapolis, Minnesota, 55426, September 1985.
10. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, Richland County, North Dakota, unincorporated area, February 3, 1981.
11. Minnesota Department of Natural Resources, Division of Waters Technical Report No. 6, The Regulatory Floodway in Floodplain Management, September 1977.

EXHIBIT 3 - ELEVATION REFERENCE MARKS
CENTER TOWNSHIP, RICHLAND COUNTY, NORTH DAKOTA

<u>Reference Mark</u>	<u>Elevation (feet NGVD)</u>	<u>Description of Location</u>
RM 1	959.60	A R.R. spike in the upstream end of the headwall on the right side of east-west railroad bridge crossing the Wild Rice R. along the section line between sections 4 and 9.
RM 2	956.49	A chiseled 'X' on top of an anchor bolt at the right end of the upstream truss of the bridge on the north-south township road crossing the Wild Rice River along the section line between sections 15 and 16.
RM 3	957.54	A chiseled 'X' on top of an anchor bolt at the left end of the upstream truss of the bridge on the east-west township road crossing the Wild Rice River near the intersection of sections 15, 16, 21, and 22.
RM 4	961.94	Chiseled '2" square' on top of the concrete abutment at the left downstream corner of the bridge on the north-south township road along the section line between sections 20 and 21.
RM 5	960.52	Chiseled 'X' on top of the concrete abutment at left upstream corner of the bridge on the north-south township road crossing the Wild Rice River along the section line between sections 29 and 30.
RM 6	958.70	Chiseled 'X' on top of the rivet in the truss anchor plate at the left end of the upstream truss of the bridge on the east-west township road crossing the Wild Rice River along the section line between sections 30 and 31.

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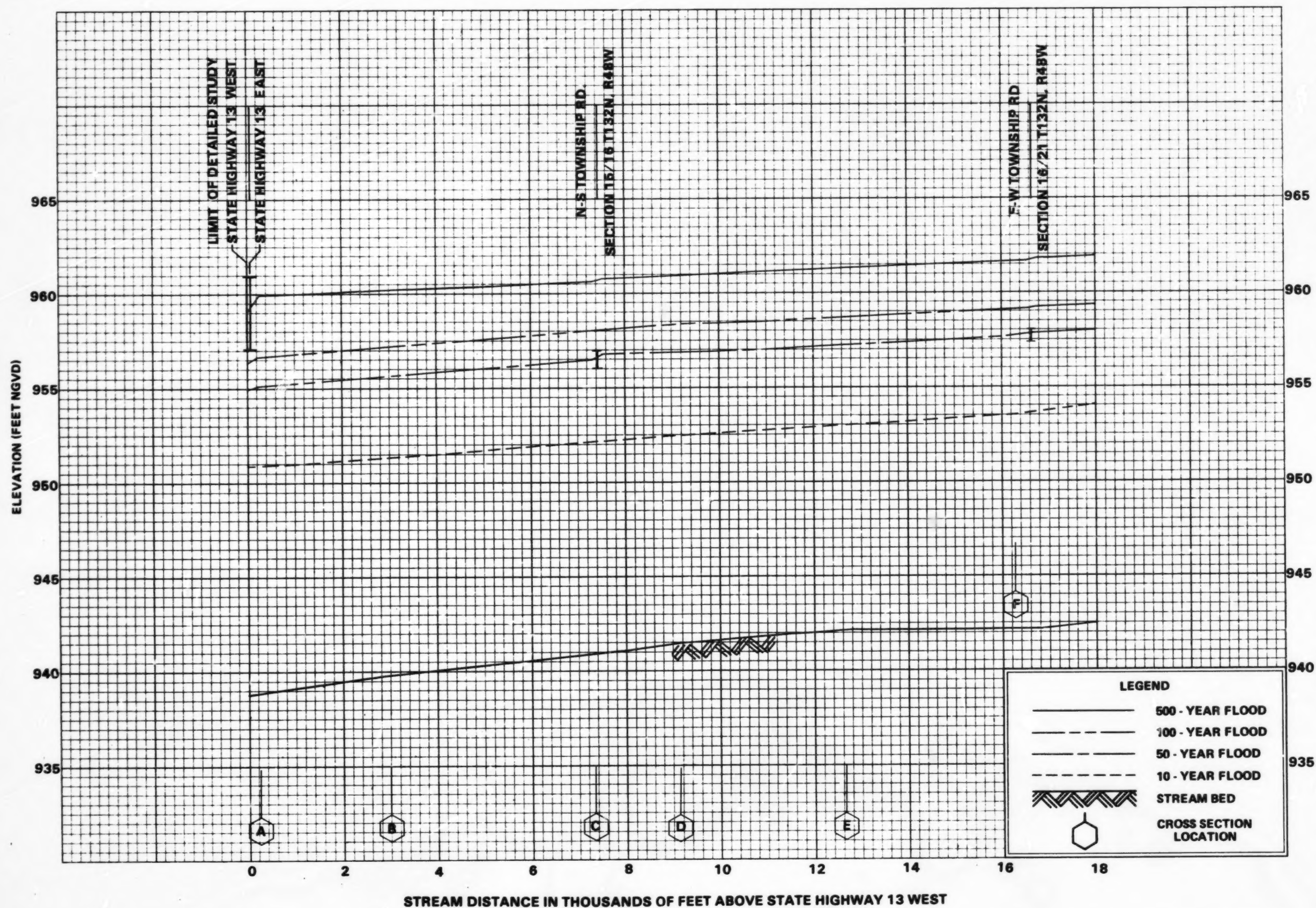


FLOOD PROFILES

BOIS DE SIOUX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CENTER, ND
(RICHLAND CO.)



FLOOD PROFILES

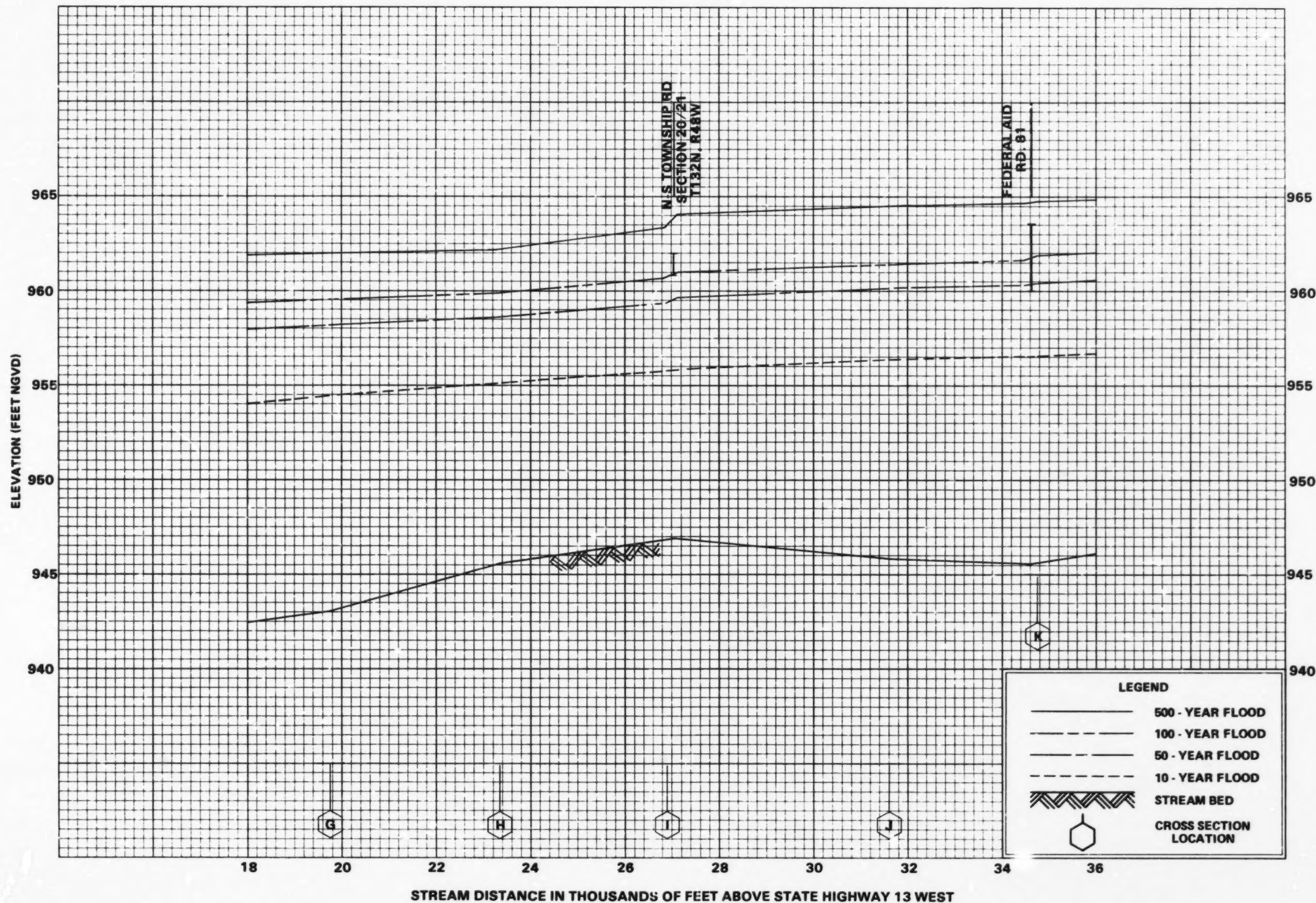
WILD RICE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CENTER, ND
(RICHLAND CO.)

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FLOOD PROFILES

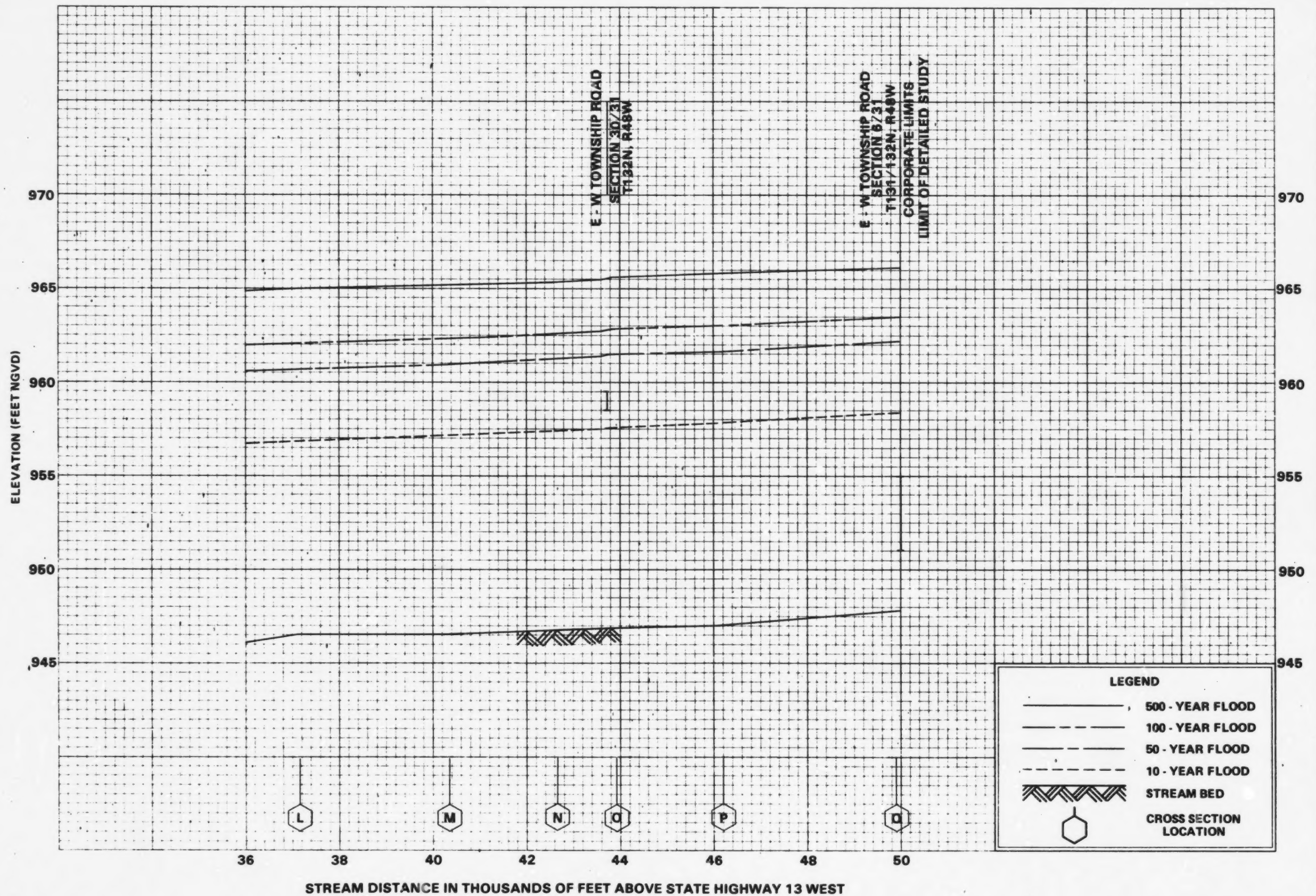
WILD RICE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CENTER, ND
(RICHLAND CO.)

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FLOOD PROFILES

WILD RICE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CENTER, ND
(RICHLAND CO.)

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